USING VIRTUAL WORLDS
What the Research Says

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The success of Second Life has supported wider use of virtual worlds, especially as learning environments. This article reviews current research on virtual worlds and draws implications for design. Specifically, virtual worlds are defined and 15 case studies are summarized through 3 lenses: inherent characteristics, pedagogical approach, and student perceptions. Constructivism and constructionism were most frequently cited as grounding theories and students were generally receptive to the use of virtual worlds despite concerns related to technological requirements and collaborative and communication tools. Research also revealed that the design of such environments may be changing from focusing on learning objectives to supporting a learning experience.

Virtual worlds are a technology available to educators for teaching and learning (Kelton, 2008). Although virtual worlds have been around as early as 1997 and even earlier as text-based, the mass cultural appeal and success of Second Life, an Internet-based 3D, user-created virtual world, has supported wider use of virtual worlds (de Freitas, 2008; Kelton, 2008; Wagner & Ip, 2009). Specifically, individuals, businesses, schools, and government use virtual worlds for a variety of reasons, including meeting, sharing, collaborating, communicating, socializing, providing services, conducting business, or creating learning environments (EDUCAUSE, 2008; de Freitas, 2008; Robbins & Butler, 2009; Wang & Braman, 2009). From an educational perspective, virtual worlds can provide classroom space, house resource materials, or support self-contained stand-alone courses conducted entirely within the virtual world (Clark, 2008). But unlike learning or content management systems, it is the sense of presence, togetherness, and "thereness" in addition to a sense of community, that is often cited as the draw to virtual worlds (Clark, 2008; De Lucia, Francese, Passero, & Tortora, 2009; EDUCAUSE, 2008; Robbins & Butler, 2009). Additionally, virtual worlds offer a place where students can conduct experiments risk free with no material costs and can control time and visual representation (Clark, 2008).

This article draws upon current research (2006-2010) to summarize the pedagogical approaches and student receptivity that may

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help to inform the design of a virtual world as a learning environment. Specifically, this article defines virtual worlds in the context of the current research, describes virtual world inherent characteristics and affordances, and summarizes 15 virtual world case studies providing implications for learning designs.

VIRTUAL WORLDS: DEFINITIONS AND INHERENT CHARACTERISTICS

A virtual world is an online, persistent, interactive environment accessible by many users simultaneously (de Freitas, 2008; EDUCAUSE, 2006). "Today's virtual worlds are immersive, animated, 3D environments" (EDUCAUSE, 2006, p. 1). Individuals, represented by avatars, control their in-world actions whether to move, communicate, collaborate, create, or socialize in-world (EDUCAUSE, 2006; Robbins & Butler, 2009).

Many different types of virtual worlds are available and their use is expected to increase. In 2008, 85 worlds existed, by 2010 this increased to 300 worlds, and by 2012 it is expected to be close to 900 worlds (KZero Worldswide, 2010). Different worlds have different capabilities depending on their intended purpose (Robbins & Butler, 2009; Smart, Cascio, & Paffendorf, 2007). De Freitas (2008) identified five categories of virtual worlds: (1) role-playing worlds that are used predominantly for leisure purposes (e.g., EverQuest and World of Warcraft); (2) social worlds that support informal social networking and interactions (e.g., Second Life and Active Worlds); (3) working worlds created to support business processes and interactions (e.g., Project Wonderland); (4) training worlds created to simulate specific training needs for the military, medical, and other professions (e.g., OLIVE); and (5) mirror worlds that combine mapping and location-aware technologies (e.g., Google Earth). For the purposes of this article, our usage of the term virtual world refers to the application of social worlds in a learning context. Social worlds do not have specific quests or tasks; they are primarily social in nature providing a place for community building activities and social communication, as well as the ability to create in-world artifacts (de Freitas, 2008; Robbins & Butler, 2009).

It is important to understand the inherent characteristics of virtual worlds so they can be leveraged in the design of a learning space. Foremost is the use of an avatar to engage the user or participant. An avatar provides not only a visual representation of the user but also a psychological immersion (Dalgarno & Lee, 2010). Through the use of the avatar in this three-dimensional space, there is a sense of presence and awareness and the ability to communicate and collaborate (De Lucia et al., 2009). Presence is explained by the sense of space and ability of the avatar to interact with the environment (de Freitas, Rebolledo-Mendez, Liarokapis, Magoulas, & Poulovassilis, 2010; De Lucia et al., 2009; Dickey, 2005a). There is awareness of others and of ongoing activities; a means to communicate through text and audio; and an ability to collaborate through the use of programmed tools (De Lucia et al., 2009). Others have noted how virtual worlds provide a temporal and spatial sharing of an environment and induce a sense of belonging to a community (De Lucia et al., 2009; Kapp & O'Driscoll, 2010). Additionally, there is a sense of self, a provision to create, and an ability to learn by doing that provides an enriched experience through watching, thinking, feeling, and doing (Kapp & O'Driscoll, 2010).

These inherent characteristics of virtual worlds, that is the sense of presence and awareness of others, the ability to communicate and collaborate, the provision to create, and learn by doing, can be leveraged for learning designs. However, technologies do not cause learning but rather afford opportunities that may lead to learning (Dalgarno & Lee, 2010; Dickey, 2005b; Winn, 2002). Technologies may "provide affordances that support instructional strategies that would not be possible without the technology" (Winn, 2002, p.

334). For example, in virtual worlds, students can conduct genetic experiments with virtual plants with time sped up in order to collect data that would normally take much longer (Clark, 2008). Students can create in-world objects to provide a means to externalize and share their understanding of what they are learning (Winn, 2002). Dickey (2005a) defined four tools that might afford learning in virtual worlds: inscription tools, discourse tools, experiential tools, and resource tools. Inscription tools allow the user to create in-world objects; discourse tools support communication; experiential tools allow interaction with the environment; and resource tools provide a means to share information.

De Freitas and Neumann (2009) noted that a virtual world offers not just avatar control but learner control as well. However, simply placing the learner in a virtual world does not necessarily constitute being immersed or engaged. How much influence the learner has on the situation or how real the experience is will determine the degree of immersion or engagement (Dreher, Reiners, Dreher, & Dreher, 2009). Kapp and O'Driscoll (2010) suggest that virtual worlds provide "the spatial, temporal, and material conditions for both immersion and interactivity, driving a multiplier effect on learner engagement" (p. 55). So it is how the learning space is designed to leverage the virtual world characteristics of shared space, time, communication, collaboration, creation, and learning by doing through the use of an avatar that can provide a variety of learning opportunities. The next section summarizes current research (2006-2010) on how virtual worlds were used as learning environments.

VIRTUAL WORLDS: LITERATURE REVIEW

Collecting relevant literature was filtered from several databases (EBSCO Host, EditLib, ProQuest, and APA PsycNET) using the keyword virtual world as a primary keyword, and research, survey, and pedagogy as secondary keywords as well as by date (since 2008) and publication in peer reviewed journals. Next, the articles were scanned by title, abstract, and methodology to identify research studies that used a social virtual world platform, higher education students as participants, provided primary research data, and specified a pedagogical approach to the design of the learning environment. This search resulted in 13 articles. However, two articles were added. One article did not provide primary research data but it exemplified constructionism as a pedagogical approach (Dreher et al., 2009). The second article provided quantitative data on improved learning in comparison to classroom based instruction (Sourin, Sourina, & Prasolova-Forland, 2006). Consequently, a total of 15 case studies were reviewed for this analysis.

The literature review is summarized in Table 1 by author(s), date of publication, research goal(s), pedagogical approach, subject domain/course/level, and the in-world activity. Pedagogical approach designates the learning theory or pedagogical model the author(s) used to describe the instructional philosophy applied in the course design. All data in the table was explicitly noted in the literature and not inferred. If a research goal or pedagogical approach was not explicitly stated, then it was not included to prevent erroneous assumptions. The research reviewed predominantly used Second Life as the social virtual world platform except for two studies; one used a proprietary, custom designed virtual world (Sourin et al., 2006) and another used Active Worlds (Bronack, Sanders, Cheney, Riedl, Tashner, & Matzen, 2008). Reasons for selecting a particular virtual world platform were not provided in the articles.

Most of the research was descriptive in nature. Others have noted that many virtual world studies offer anecdotal information and personal impressions that lack generalization across a broader population (Dalgarno & Lee, 2010). The following table summarizes the research goals, the applied pedagogical

TABLE 1
Virtual Worlds Research

Authors (date)	*Research Goal*	*Pedagogical Approach*	*Domain, Course, and Level*	*In-World Activity*
Chang, Gütl, Kopeinik, & Williams (2009) (*N* = 16)	• Evaluate the use of Second Life for collaborative learning	• Collaborative learning	• Information systems: business problem analysis; senior level undergraduate	• Write a collaborative (small group) essay
De Lucia, Francese, Passero, & Tortora (2009) (*N* = 26)	• Evaluate the use of Second Life for synchronous distance lectures	• Collaborative learning	• Fundamentals of computer science	• Actively participate in a group lecture
Jarmon, Traphagan, Mayrath, & Trivedi (2009) (*N* = 5)	• Examine the instructional effectiveness of Second Life as an experiential learning environment	• Experiential learning; collaborative learning	• Communicating across disciplines; graduate level	• Create a small group project in Second Life that reflects and uses interdisciplinary communication strategies
Schiller (2009) (*N* = 32)	• Evaluate an assessment framework that evaluates the learning objectives and learning processes of the Second Life project	• Learner-centered; active learning	• Master's of business administration: information technology and business transformation; graduate level	• Explore and participate in preidentified virtual businesses; chat with others at these places
Shen & Eder (2009) (*N* = 77)	• Examine students' intentions to use Second Life as a learning environment; explore factors associated with student intentions	• Collaborative learning	• Business school: e-commerce class and management information systems class; undergraduate (junior and senior level)	• Attend a software information booth at a business corporate center and collaboratively solve a computer configuration problem
Wagner & Ip (2009) (*N* = 42)	• Test the usefulness of Second Life as an action learning environment in a senior management information systems course	• Action learning	• Information systems: virtual organizations and global teamwork; senior level undergraduate	• Build and run an online business in Second Life
Wang, Song, Xia, & Yan (2009) (*N* = 20)	• Find appropriate ways to integrate Second Life into English as a foreign language course	• Social constructivist perspectives: interaction, collaboration	• School of foreign languages: English (as a foreign language); undergraduate sophomores	• Attend lectures, virtual tours; participate in small group discussion and one-on-one interviews with an American partner

Wang & Braman (2009) (*N* = 48)	• Explore the benefits and problems with Second Life in the classroom, how to adopt virtual world technology, and how to effectively use virtual worlds in a learning environment	• Active Learning	• Main study: Computer and Information sciences: computers and creativity; introductory undergraduate	• Build scripted objects in Second Life to study the effects of 3D programming and to compare Linden scripting language with other scripting languages
Mayrath, Sanchez, Traphagan, Heikes, & Trivedi (2007) (*N* = 18)	• Develop an understanding of how to effectively use Second Life for instructional purposes		• English: world literature and visual and verbal rhetoric (undergraduate freshman, two-semester course)	• Semester 1: Build a campus in Second Life; Semester 2: Role play a selected leadership model
O'Connor (2009) (*N* = 7, 15, 12)	• Determine if and how virtual worlds can be leveraged as a learning environment	• Constructivist principles	• Teaching: (three courses) science project, introduction to pedagogy, and advanced pedagogy; graduate level (master's)	• Explore, document, and share Second Life sites used for science related instruction
Good, Howland, & Thackray (2008) (*N* = 41)	• Investigate Second Life affordances as a learning environment	• Problem-based learning; constructionism	• Interactive learning environments	• Build an interactive learning experience using Second Life for vocational type projects
Dreher, Reiners, Dreher, & Dreher (2009)		• Constructionism	• Information systems: business processes and software development	• Create a supply chain simulation; Create an in-world lecture hall with supporting tools
Lu (2010) (*N* = 6)	• Determine if students followed the presented design principles and what were the student learning outcomes	• Collaborative, student-centered, activity-based	• Technology course; undergraduate and graduate level students	• Create 3D objects within a virtual space and conduct an art exhibition to showcase the virtual space
Sourin, Sourina, & Prasolova-Forland (2006)			• School of computer engineering: shape modeling	• Create objects using shape modeling functions
Bronack, Sanders, Cheney, Riedl, Tashner, & Matzen (2008)		• Social constructivist: presence pedagogy	• Multiple courses; graduate level, K-12 educators	• Activities using help seeking, communication, and collaboration

approaches, and the research findings in the selected case studies.

Research Goals

Research goals in the 15 case studies selected included evaluating the use of a virtual world: as a tool to effectively support general education or a specific domain such as foreign language; as a tool to support a specific pedagogical approach (collaborative learning, experiential learning, action learning); and as a synchronous distance learning environment. Other research goals included developing an assessment framework for virtual world applications and understanding the nature of student intentions for using virtual worlds. The research method applied in these studies was predominantly mixed methods and data collection instruments included survey, one-on-one interviews, focus groups, review of student artifacts, and observation. Student perceptions on the use of virtual worlds were most often the variable measured.

Pedagogical Approaches

A variety of pedagogical approaches were implemented in these virtual world studies including collaborative learning, experiential learning, action learning, active learning, problem-based learning, constructionism, and social constructivism. Presence pedagogy which is based on social constructivist theory was also used (Bronack et al., 2008) as well as the principles associated with the "six learnings of Second Life" (Lu, 2010). Subject domains included business, software programming, interdisciplinary, social science, foreign language, teaching, and instructional design, at both the graduate and undergraduate levels. The in-world activities ranged from actively participating in a lecture to the more complex such as creating and running an online business.

Research Findings

Overall, the research findings indicated that students had a positive attitude towards using Second Life as a learning environment (Chang, Gütl, Kopeinik, & Williams, 2009; De Lucia et al., 2009; Jarmon, Traphagan, & Mayrath, 2008; Jarmon, Traphagan, Mayrath, & Trivedi, 2009; Lu, 2010; Schiller, 2009; Wang, Song, Xia, & Yan, 2009; Wang & Braman, 2009). Specifically, students were motivated to learn in Second Life and found Second Life helped in their learning (Schiller, 2009). However, with the exception of one study (Schiller, 2009), most students noted the steep learning curve and initial technical and navigational difficulties associated with virtual worlds, albeit these subsided with time (Jarmon et al., 2008; Jarmon et al., 2009; O'Connor, 2009; Wang et al., 2009). In one study, only 58% of the students felt Second Life was easy to use (Wang & Braman, 2009). To improve student perceptions, Mayrath, Sanchez, Traphagan, Heikes, and Trivedi (2007) noted the need to align course objectives with the in-world activity, explain to students the instructional rationale for the Second Life activity, and match the activity to the student's Second Life skill capabilities. Shen and Eder (2009) also noted that it is important to increase student perception of how useful the Second Life application is to their learning and that having fun with the Second Life activity is significantly related to the acceptance of using Second Life. Interestingly, Wagner and Ip (2009) found that even though students criticized the high level of effort for the Second Life activity, this criticism did not significantly affect the students' value of learning.

In general, students had a sense of community and presence in the virtual world. Students felt a part of a community (Bronack et al., 2008). They had a sense of presence (Jarmon et al., 2009) but could also feel overwhelmed by the amount of things to focus on, where to go, or be potentially deceived by others (Wang & Braman, 2009). Students got to know each other through their avatar usage, hearing oth-

ers speak, sensing personalities, collaborating, and virtual presentations (O'Connor, 2009). Students tended to talk more and across a variety of topics with their instructors when in-world, thus promoting the instructor as a guide rather than an authority (Good, Howland, & Thackray, 2008). Even though the virtual world environment was found to support synchronous communication and social interaction (De Lucia et al., 2009), students preferred other, more familiar, social networking technologies for communication (Wang & Braman, 2009).

Overall, students felt the Active Worlds application promoted continuous, collaborative, and active learning (Bronack et al., 2008). However, Chang et al. (2009) noted that Second Life collaboration tools need to be more flexible, easier to use, and support dynamic content. It was also noted that some of the problems students encountered while using Second Life for collaborative activities were the same as those encountered in collaborative projects in general (e.g., scheduling and perceived effectiveness) (O'Connor, 2009). Only one study explicitly noted the successful implementation of their pedagogical approach; experiential learning was considered supported by Second Life (Jarmon et al., 2009). Students also recognized the value of action learning (Wagner & Ip, 2009). In terms of learning effectiveness, Schiller (2009) reported that students did apply their classroom knowledge to the Second Life activity; Lu (2010) found that students did reapply the art design principles taught in the course; and Sourin et al. (2006) reported a 14% increase in the mean exam mark over past courses not using their proprietary virtual world.

In addition to these research findings commensurate with their research goals as noted in Table 1, other lessons learned and suggestions for future designers were included in the literature, some of which are noted in the next sections, which discuss the literature in more detail. Specifically, the discussion will focus on a review of the literature through two lenses: the applied pedagogical approaches and student receptivity, perceptions, and learning effectiveness in virtual worlds

VIRTUAL WORLDS: PEDAGOGICAL APPROACHES

The analysis revealed that the pedagogical approaches used in the design of virtual world learning environments were rooted in constructivism. Constructivism is based on the general view that "learning is an active process of constructing rather than acquiring knowledge" (Duffy & Cunningham, 1996, p. 171). Situations, activities, and social interactions in constructivist learning environments are designed to constantly challenge the learner's understandings, which results in new meanings (Dabbagh & Bannan-Ritland, 2005). Several pedagogical models have been developed based on constructivist learning theory. Examples include problem-based learning, action learning, situated learning, experiential learning, and collaborative learning to name a few. Characteristics of these models include designing authentic learning activities that are complex, realistic, and relevant; promoting social negotiation as an integral learning activity; supporting multiple perspectives and multiple modes of content representation; and encouraging ownership in the learning process (Dabbagh & Bannan-Ritland, 2005; Driscoll, 2000).

In these studies, problem-based learning, action learning, experiential learning, active learning, collaborative learning, social constructivism, presence pedagogy, and constructionism were applied as pedagogical approaches in the design of a virtual world learning environment. A brief description of each follows.

Problem-based learning is a pedagogical model that engages students in solving an ill-structured problem using hypothetico-deductive reasoning and assumes no formal prior knowledge of the learning domain (Dabbagh & Bannan-Ritland, 2005). Good et al. (2008) applied this model in a virtual world in a

course on interactive learning environments. Students were presented with problems provided by actual clients in topic areas the students had little or no knowledge of and were then asked to create learning solutions within Second Life—an unfamiliar environment. They found that "the combination of problem-based learning with Second Life provided a number of distinct advantages, offering an ideal venue in which to exercise authentic problem-based learning, reinforcing the facilitative role of the instructors, whilst offering motivation and relevance for the students" (Good et al., 2008, p. 172).

Action learning involves a small group taking action to solve a real problem and supports reflective thinking and learning (Marquardt, 2004). It follows a cycle of action, experience, understanding, and planning for new action to repeat the learning cycle (Wagner & Ip, 2009). In this study, students were to build and operate an online store in Second Life to experience and apply business and system development principles. The researchers intended for the student to recognize the different phases in action learning as they occurred during the exercise since these were considered to mirror the steps taken in systems development projects. Although the students recognized the value of action learning and understood its phases, they were not able to recognize the phases as they occurred in the exercise (Wagner & Ip, 2009). However, the authors noted that the survey items may also have influenced this finding. So although the students exhibited an increase in e-business insights and system development insights, the students' awareness of action learning as it occurred during the exercise needed improvement (Wagner & Ip, 2009).

Experiential learning is another constructivist-based pedagogical model applied in the design of a virtual world. Similar to action learning and problem-based learning, Kolb's experiential learning theory follows a cyclical process of four steps to build understanding and expertise (as cited in de Freitas & Neumann, 2002). For experiential learning, the steps are concrete experience, reflective observation, abstract conceptualization, and active experimentation (de Freitas & Neumann, 2002; Jarmon et al., 2009). In the Jarmon et al. (2009) study, graduate students of multidisciplinary backgrounds were to apply and demonstrate their understanding of interdisciplinary communication within the context of a class project to be conducted within Second Life. Results indicated that Second Life supported experiential learning by affording collaboration, the testing of hypotheses with minimal risk, and providing relevance to the real world, and that the experiential learning cycle was initiated and enhanced by the sense of presence (Jarmon et al., 2009).

Active learning as a pedagogical approach was applied in two studies. Active learning stresses the active processing and application of information over passive listening, using strategies that rely on talking, listening, reading, writing, and reflecting (Meyers & Jones, 1993). Wang & Braman (2009) found that Second Life activities relative to class discussions could be effectively designed to engage and motivate students as well as afford them the opportunity to actively pursue understanding the materials. Schiller (2009) noted active learning in their pedagogical approach but in a larger context of learner-centered design. The learner-centered approach supports learners participating in course decisions and taking responsibility of their learning; teachers provide the appropriate content to promote learner skills and awareness; teachers are learning facilitators; and evaluation is not singular in nature (Schiller, 2009). Schiller's (2009) study results indicated the students were motivated to learn more, the project was engaging, and a design based on the combination of learner-centered with active learning was effective for information systems courses.

Collaborative learning was applied in three studies. Collaborative learning emphasizes "the joint construction of knowledge, social negotiation, and student reliance on peers and teachers as learning resources" (Dabbagh & Bannan-Ritland, 2005, p. 326). The learning

environment developed by Chang et al. (2009) identified and accommodated specific features to support collaborative learning. From a pedagogical aspect, the learning environment supported private, small group discussion areas; a teacher-student office; a recreational area for inter- and intragroup discussions; and collaboration tools. The results indicated students felt the environment aided them in being an effective working group and most said they would re-use Second Life for collaborative tasks. However, the students also noted that collaboration tools were difficult to operate; there were no tools to diagram their ideas; and the avatars were limited in showing emotion even though they used voice over Internet protocol and Skype. In the case of De Lucia et al. (2009), their learning environment supported similar features for collaborative learning: a common campus area, areas for collaboration, lecture rooms, and recreational areas. In their study, the students participated in three synchronous lectures. The teacher used voice to communicate while students used gesture boards and text chat to communicate questions and responses. The learning environment supported synchronous communication and social interaction. Students indicated a sense of awareness, presence, and communication, and felt they belonged to a community (De Lucia et al., 2009). Although Shen and Eder (2009) used collaborative learning as a pedagogical approach, their study examined the factors that may influence students' intentions to use Second Life. Implications for design included designing team-based activities that promote rich social interactions.

In social constructivism, knowledge is socially constructed; learning is social in nature as in a community of practice; and the learner progresses from novice to expert under the guidance of expert community of practice members (Bronack et al., 2008). A good application of social constructivism in a virtual world was the use of the virtual world for learning English as a second language (Wang et al., 2009). In this study, the students had to interact socially with a preidentified group of English speaking students to practice becoming expert English speakers. The research revealed that in future courses, once students become adept with Second Life usage, the students could interact in a more naturalistic manner of improvised interactions.

The Presence Pedagogy (P2) Model is a relatively new social constructivist pedagogical model proposed by Bronack et al. (2008). The P2 Model adheres to ten tenets which are described in the context of a virtual world: ask questions and correct misconceptions; stimulate background knowledge and expertise; capitalize on the presence of other; facilitate interactions and encourage community; support distributed cognition; share tools and resources; encourage exploration and discovery; delineate context and goals; foster reflective practice; and utilize technology to achieve and disseminate results (Bronack et al., 2008). Serendipitous interactions are core to this model but the authors note that creating "an environment that effectively capitalizes on the presence of others requires careful planning and thought and is fostered by well-designed spaces" (Bronack et al., 2008, p. 63).

Constructionism was another pedagogical approach used in the case studies. Constructionism is similar to constructivism but differs in that it assumes learning is enhanced when the student creates personally meaningful artifacts (Dreher et al., 2009; Papert & Harel, 1999; Sullivan, 2009). For an information systems course, students had to create a supply chain simulation in one study while in another the students created an in-world lecture hall with supporting tools (Dreher et al., 2009). These projects were found to be engaging and effective for deeper understanding than other projects accomplished in more traditional teaching methods (Dreher et al., 2009). Having summarized the pedagogical approaches found in the research, the next section looks at student receptivity, perception, and learning within virtual worlds.

VIRTUAL WORLDS: STUDENT RECEPTIVITY, PERCEPTION, AND LEARNING

The research studies targeted three variables: student receptivity to using virtual worlds, student perceptions of using virtual worlds, and student learning in a virtual world learning environment, albeit most research focused on student perceptions.

Student Receptivity

Receptivity refers to the user acceptance of a new technology. Many models exist that capture the nature of user acceptance of technologies in general (Venkatesh, Morris, Davis, & Davis, 2003). However, in the two studies that specifically targeted the nature of student acceptance of Second Life as a learning environment, both used the Technology Acceptance Model (TAM). "TAM posits that two beliefs—Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) —determine one's Behavioral Intention (BI) to use a technology" (Shen & Eder, 2009, p. 226). The goal of these two studies was to determine the variables that influence the behavioral intention of the person to accept and use virtual worlds as a learning environment. Knowing these variables and their relationships can help in the design and implementation of a virtual world as a learning environment.

In one study, Shen and Eder (2009) were interested in undergraduate business students' acceptance and intention to use virtual worlds for educational purposes. Using TAM and its extended studies, computer playfulness, computer self-efficacy, and computer anxiety were evaluated as antecedents to PEOU while the relationship between PEOU, PU, and BI were also examined. In the study, students were to conduct Second Life activities, some collaboratively. Post-course, the students completed a seven-point Likert scale questionnaire targeting these variables as well as collecting information on demographics, current use of networking sites, and prior knowledge of Second Life. The majority of the respondents (68.8%) had never even heard of Second Life before the class and only 3.9% had a Second Life account that they used regularly. In contrast to the TAM and its extended studies, the data indicated that PEOU did not directly influence the student's BI to use Second Life in a learning environment and computer anxiety had no significant effect on PEOU (Shen & Eder, 2009). Shen and Eder (2009) interpreted the findings from this study to indicate that use of Second Life as a learning environment is plausible; its use needs to account for student perceived usefulness; and activities should be collaborative to encourage social interaction.

In another study by Fetscherin and Latteman (2008), several variables were investigated to assess user acceptance of Second Life based on TAM. Each variable included a group of two to five items (statements) to be rated on a five-point Likert scale. For example, the variable "perceived ease of use" included the item: easiness to learn to operate the system, while the variable "perceived usefulness" included the item: Second Life improves communication with other people. A convenience sampling approach was used based on emails and notices sent to Second Life users. From the 249 surveys collected online, the results indicated that the "perceived value of communication, cooperation, and communication channels on virtual worlds" (p. 240) are the most important determinant in the adoption of virtual worlds with perceived usefulness as next most important. However, it should be noted that the sampling used subjects already using Second Life who may have a different perspective than those with limited or no prior knowledge of Second Life.

These studies indicate that student receptivity of Second Life as a learning environment relies on student perceived usefulness of the technology and the value they place on collaboration and communication. Without further studies on user acceptance, these findings may indicate to instructional designers the importance of aligning learning objectives, strategies, and activities with these significant

receptivity variables. Additionally, findings from these types of receptivity studies may be useful to inform the nature of survey instruments for student perceptions of using virtual worlds as a learning environment.

Student Perceptions

Student perceptions were obtained mostly through course evaluations on the use of the virtual world. Evaluations were collected from survey instruments, basically Kirkpatrick Level 1 type surveys; whereby a Level 1 survey solicits student reaction to a course (Piskurich, 2006). Although many instruments targeted the same type of data such as ease of use, the individual test items were different in each survey. The researchers performed and reported on quantitative analyses of their particular survey instruments. Wang and Braman (2009) noted that even though the students enjoyed Second Life, found it useful as a learning environment, had the knowledge to run Second Life, only 58.3% felt it was easy to use, and hence only 45.8% would use Second Life on a regular basis. In another study, the virtual application was replacing the classroom lecture by a virtual world synchronous lecture (De Lucia et al., 2009). The survey instrument intended to measure the researcher's defined inherent characteristics of a virtual world: presence, communication, awareness, perceived sociability, and the virtual environment. The 32 presence test items measured four variables: control, realism, sensory, and distraction. The findings indicated a high sense of presence even though the students only used text chat (no audio). It was also noted that the presence test items may not be applicable to collaborative environments, i.e., to areas where more than one person is interacting. In another study (Jarmon et al., 2008), it was reported the students enjoyed the virtual world and that it increased their engagement in the course, however, the students had mixed feelings in the ability of the virtual world to facilitate collaboration and communication. This was the same study noted previously where half the students felt the team project was irrelevant to the course. In another study (Schiller, 2009), the evaluation test items focused on learner motivation, attitude, and ease of use. The results were positive with the exception that moving the avatar was difficult.

Student perceptions are also affected by the relevance and authenticity of the specific activity conducted in the virtual world to the course objectives. Several researchers noted the importance of aligning appropriate activities with the desired learning outcomes (Jarmon et al., 2008; Jarmon et al., 2009; Mayes & de Freitas as cited in de Freitas & Neumann, 2009; Mayrath et al., 2007; O'Connor, 2009; Schiller, 2009; Wang & Braman, 2009). In one study, Second Life was integrated into a two-semester undergraduate world literature and rhetoric course (Mayrath et al., 2007). In the first semester, one learning objective addressed the integration of visual and verbal rhetoric as reflected in the campus architecture. The Second Life activity required the students to construct an ideal campus in Second Life. However, students found it difficult to connect the activity to the course content and the programming requirements were initially beyond the students' capabilities. In the second semester, one learning objective dealt with exploring leadership through role models. The corresponding Second Life activity required the students to take on the persona of their role model and provide a presentation in Second Life of that person. The second semester activity was ranked consistently higher across all survey items causing the authors to conclude that students' perceptions of Second Life will depend in part on how well the activities align with the instructional objectives and context, and the ability of students to implement the learning activity without undue difficulty.

The effect of the amount of time spent on orientation may also explain student perceptions. Orientation covering virtual world functionality and skill sets required for course completion is really mandatory. One researcher noted that orientation should be part of the learning objectives to promote the

importance of acclimating to the environment and hence set time aside for that accomplishment (O'Connor, 2009). In another study, the ease of use of the avatar was rated lowest of the survey items but perhaps because four people shared one avatar during in-class time though it was considered to increase group cohesion by having to jointly accomplish the activity (Schiller, 2009).

Comparing student perceptions of virtual worlds across a limited number of studies is problematic given the variety in design and implementation of the learning activities. For example, one study focused on the use of the virtual world for synchronous class presentation (De Lucia et al., 2009). Comparing students' perceived usefulness of a virtual world in this application to their perceived usefulness in a more complex application in which the students are required to develop an online business seem will most certainly lead to different results, at least without further investigation. With limited studies, it may be best to code, summarize, and note advantages and disadvantages along with student perceptions to better interpret such results.

Student Learning

Limited research was found on student learning as related to the use of virtual worlds. This may be because student learning is generally not measured by standardized, knowledge-based tests in constructionist and constructivist learning environments. Rather, the learning strategies and ensuing activities result in the development of artifacts that reflect students' externalization of their understanding of the content (Schiller, 2009). These artifacts then aggregate into a portfolio, commonly for peer- and self-assessment diminishing the possibility for quantitative comparisons of learning achievement.

Limited data was provided on student learning in the research analyzed. Wang and Braman (2009) reported a class that was required to write scholarly papers on the intersection of business and information technology. Four groups of four students each were selected to write about the impact of virtual worlds on business through first hand investigations of Second Life. These students were said to have outscored others based on quality, quantity, and peer assessment of the papers. However, the instructors did note that the novelty of the topic may have been more motivational than other topics. In another study (Sourin et al., 2006), a computer graphics course on shape modeling indicated a 14% increase over prior course exam scores. The prior course was delivered via a learning management system although the students had to have access to laboratory-based software. The virtual world course allowed the students to work online, create shapes, sculpt the shapes, and save in a showcase type room to share with others. This study also points to how well the affordances of a virtual world were applied: the three-dimensionality of the virtual world supported the three dimensional shape functions and the showcase room supported peer-review feedback through imagery and multiple viewpoints.

IMPLICATIONS FOR DESIGN

The literature review indicated researchers found the use of virtual worlds to be positive indicating they would use a virtual world again as a learning environment. However, several caveats were noted: making sure the activity is relevant, the students have the virtual world skills necessary to accomplish the activity, and the technical requirements of the computer meet the needs. The latter comment was repeated resoundingly across the research. Additionally, the anecdotal and suggested recommendations may actually be specific to the learning environment and not generalized.

When considering a virtual world as a learning environment, the first question that needs to be addressed is whether a virtual world is the appropriate technology for the course goals. If the activity relies solely on social networking, then educators or instruc-

tional designers should consider using a technology that is more familiar to the students. For example, an instructor may want students to share and socially negotiate their interpretation of an article. In this case, a blog may be a simpler and more familiar solution for this instructional activity as opposed to meeting in a virtual world for a discussion. So identifying the most appropriate technology to use to meet the course goals is paramount (Wang & Braman, 2009). Some researchers have noted that if the virtual world is only used to support synchronous learning, then the potential to use virtual worlds in a manner different from traditional synchronous technologies is lost (Calongne, 2008; Dreher et al., 2009). However, others feel that just the ability of a virtual world to support interaction, real-time discussion, and shared experiences through the sense of presence may be worth the effort to use a virtual world as a learning environment. In one study, a distance learning course was transitioned to a synchronous distance learning course whereby Second Life served as a presentation and meeting area (O'Connor, 2009). The new approach allowed the geographically dispersed students to virtually meet their cohorts, to sense their personalities, to work collaboratively, and to learn from peer presentations. It additionally allowed for guest lecturers to present directly to the class. A sense of camaraderie was developed and the students acted as if the activities were taking place in the real world (O'Connor, 2009). These were valued additions to the course providing the sense of presence, awareness, and belonging to a community.

The inherent characteristics of collaboration, communication, and creation can be readily leveraged using preexisting tools native to Second Life, such as a slide presentation board, brainstorming board, and whiteboard that are readily available to support specific learning activities (Chang et al., 2009; Jarmon et al., 2009; O'Connor, 2009). Three-dimensional objects can be created such as for a computer graphics class (Sourin et al., 2006) or for an art class (Lu, 2010). Additionally, students can create and store note cards in a folder system that can be kept or shared by the students (Good et al., 2008). Text chat transcripts can be saved for documentation (Schiller, 2009) while the built-in Second Life camera and Machinima can be used to document places visited (O'Connor, 2009). Machinima is a Second Life tool that supports the video recording of what is happening on the screen. It may better convey to an audience the places visited and the experiences encountered by the user. Other functionalities may be specifically programmed into the virtual world. In the case of Second Life, some researchers have programmed a collaborative document-sharing tool that makes use of Google docs (Chang et al., 2009; Good et al., 2008; Schiller, 2009). Another expanded the slide presenter and collaborative capabilities through SLoodle, a combination of Second Life with an open-source learning management system Moodle and created a dynamically loaded presentation board (De Lucia et al., 2009).

In terms of the virtual world characteristic of space, some studies have specifically designed spaces that provide different functionalities whereby visual cues and metaphors are used to alert the user to the expected function of the space (Bronack et al., 2008). In the case of Genome Island, levels of a wall-less building provided distinct areas of learner activities while an outdoor deck with seat cushions was intended as a discussion space (Clark, 2008). In another study, small buildings were collocated and made available for simultaneous, multiple, but private, small group collaborative workspaces (Chang et al., 2009). So the three dimensional space of virtual worlds not only provides a sense of presence and awareness through the use of the avatar but can also be leveraged to organize tools, functionalities, and content.

The design of a virtual world application is not just about leveraging the inherent characteristics and built-in tools according to a selected pedagogy and course goals. For de Freitas and Neumann (2009), it's the use of immersive learning that "implies a shift from considering and designing learning tasks to

choreographing learning experiences as a whole, mediated by structured and semi-structured social interactions" (p. 82). Learning outcomes are not single stand-alone units matched to instructional strategies and activities, albeit that's still important; but by using a more exploratory approach, learning may in fact rely more on learning scenarios whereby multiple learning outcomes may be intertwined for design and assessment and linearity in learning is diminished. Extending the experiential learning model by Kolb (1984) (as cited in de Freitas & Neumann, 2009), a new exploratory model was developed that inserts a new step, "exploration"; making the learning cycle: experience, exploration, reflection, abstract conceptualization, and testing (active experimentation). This new step, exploration, specifically addresses learning through collaborative activities, communication, and observations (de Freitas & Neumann, 2009) —these are some of the inherent characteristics of a virtual world noted previously.

Similar to de Freitas & Neumann (2009), Kapp and O'Driscoll (2010) have also transitioned the training design process from learning tasks to learning experiences. Kapp and O'Driscoll (2010) have developed design principles "to create engaging episodic interactions that lead the learner along an optimal flow state of challenge and reward as they rapidly—but often not consciously—assimilate new learnings along the way" (p. 70). These design principles are broken into two categories; the first are the grounding principles: instructionally grounded and reflectively synthesized. The remaining principles define the experiential principles of: participant centered, contextually situated, discovery driven, action oriented, consequentially experienced, and collaboratively motivated. Similar to the Presence Pedagogy (P2) Model, these tend to align with constructivist learning theories. These design principles are then encapsulated within a macrostructure of agency, exploration, connectedness, and experience to support the design process. Each macrostructure is associated with certain learning archetypes (similar to learning activities) and these archetypes are continuing to be developed and assigned to a macrostructure. Scopes (2009) has retroactively applied these principles through the application and extension of Kapp and O'Driscoll's (2010) learning archetypes to three case studies to investigate the applicability and implementation of the design principles. The use of the learning archetypes was found to be an effective support in the design of a virtual world learning environment.

So while our instructional design processes of aligning learning theory to pedagogical model to instructional strategy to learning activities with course goals remains intact, perhaps there is a shift as to what constitutes a learning environment and what new affordances can be derived from a virtual world to create effective learning.

CONCLUSION

Virtual worlds provide a learning environment where time and space can be manipulated and students can learn and practice without risk or consequence. Virtual worlds afford opportunities to learn through their sense of presence and awareness as well as supporting collaboration, communication, and creation capabilities. Most virtual world learning environments in the literature align with constructivism, social constructivism, or constructionism. The applied pedagogical models include collaborative learning, experiential learning, action learning, active learning, and problem-based learning.

Overall, the analysis of this literature revealed that using virtual worlds as a learning environment is a positive experience. Students had a positive attitude to using virtual worlds as a learning environment although issues with technology, navigation, and communication and collaboration tool usage resulted in frustration. Student receptivity of Second Life as a learning environment relied on student perceived usefulness and the value placed on collaboration and communication. Perceived

usefulness may indicate the importance of aligning learning objectives, strategies, and activities with virtual world activities. The analysis also revealed the following recommendations to ensure effective learning designs: making sure the activity is relevant, realistic, and collaborative in nature, the students have the skills necessary to accomplish the activity in-world, and the technical requirements of the computer meet the needs of virtual world platforms. The research suggests that designers need to approach a learning problem as with other instructional design problems: identify the desired learning outcomes, develop learning objectives, and identify an appropriate pedagogical model, instructional strategies, and learning activities that, in this case, align with the affordances of a virtual world.

Although not fully exploiting the capabilities of the virtual world, using a virtual world as a replacement for the classroom or as a synchronous distance learning class has merit through its ability to create a sense of presence, awareness, and belonging to a community; important factors to learning. More design guidance may be needed to appropriately leverage the instructional affordances of a virtual world. Although virtual worlds can accommodate current learning theories and pedagogical models, these theories and models may need modification to account for the richer affordances of a virtual world; where learning is not an event but an experience. There is much room for research in this still young and developing technology.

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